

Assessments and treatments for pedophilic disorder: a literature review

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Abstract: Pedophilic disorder has become a topic of growing awareness and interest for the medical professional, as the sexual offending against children has gradually become a social issue and health concern. Pedophilic disorder is defined as having recurrent sexual preference for prepubescent children that is characterized by having persistent thoughts and fantasies as well as intense sexual impulse and arousal. What factors primarily cause the pedophilic disorder remain unknown so far. The main purpose of this review is to provide an overview of the techniques and methods that have or have not yet been applied to assess the pedophilic disorder, as well as the promising treatments used in conjunction with the psychotherapies in terms of neurobiology and cellular biology.

1. Introduction

Sexual offending against children, widely known as child sexual abuse, is always an extremely significant issue and there's already a growing public recognition that the prevention of the sex crime towards children has become a critical health concern in current social stratum and the scientific field. According to a meta-analysis of 55 studies conducted on the prevalence of sexual offending against children, 19.5% of girls and 10% of boys across 24 countries, on average, have undergone sexual abuse which was measured by an estimated range of severity rates- from extreme behaviors involving forced penetration to relatively milder acts involving no direct or physical contact [1]. Furthermore, a higher risk of revictimization was suggested to be associated with various social, behavioral, and psychological problems. The resulting psychological problems include certain psychiatric disorders like post-traumatic stress disorders, anxiety disorders, and personality disorders; the long-term effects of the sexual offend could result in certain physical issues such as HIV infection, sexual dysfunction, anhedonia, and certain social issues such as incapability of asserting emotional needs, and fear of intimacy [2, 3, 4, 5].

Though sexual offending is highly overlapping with the clinical identifications and constructs of disorders associated with either typical or atypical sexual preferences- such as voyeuristic disorder, pedophilic disorder- sexual offending is not intrinsically congruent with or entirely restricted to them [6]. Sexual offending is the consequence of both the social and the clinical issues. However, based on self-report and objective measures of sexual interests, a higher rate of recidivism was found in sex offenders with pedophilic disorders. And pedophilic disorder is defined as the recurrent, intense sexual impulse towards the prepubescent children according to the DSM-5 [7]. Moreover, in several case studies conducted previously, people suffering from pedophilia were found to be a victim of sexual abuse in their childhood themselves. And sex offenders with pedophilic disorders were observed to have a higher chance of being traumatized by the childhood sexual abuse compared with other groups of sex offenders [8]. Hence, actions should be taken to prevent the occurrence of recidivism, or even to prevent the potential perpetrators from committing the crime from the very beginning. The aim of this review is therefore to provide insight into the important lines of research and investigations on the assessments of pedophilic disorder, while presenting the existing treatments and the role of particular molecules in the potential therapeutic approaches to this psychiatric disorder.

2. Diagnosis and assessments for pedophilic disorder

The prevalence of pedophilic disorder is hard to estimate. According to DSM-5, under the circumstances when a person reports an absence of feelings of guilt or shame towards those sexual urges toward the prepubescent children, or when a person's self-reported or legally recorded background indicates that they have never act on those sexual impulses, the person is considered having a pedophilic sexual orientation rather than being diagnosed as pedophilic disorder. Moreover, only a portion of the sex offenders who commit sexual abuse against children could be theoretically diagnosed as pedophilic disorder, as the observable signs of puberty are not representative characteristics that could distinguish those children who are attractive to people with pedophilic disorders from those who are not [9]. Current and prospecting assessment methods include clinical interviews and questionnaires, neuropsychological testing, phallometric testing, and eye tracking system. Amongst all 4 approaches listed here, phallometric testing is considered the gold standard diagnostic tool for pedophilic patients, whereas clinical interviews and questionnaires by which data are relatively easy to collect are considered the worst. Multiple neuropsychological tests need to be carried out synchronously, and the combinatorial results could then provide us with insight into the assessments for pedophilic disorder.

2.1 Clinical Interviews and questionnaires

Questionnaires are frequently used as the diagnostic tool for mental health disorders by health care professionals due to its advantages for being quick and easy to complete. So, Pedophilic Fantasies, Desires, and Activities Questionnaire (PFDAQ) was developed to assess the level of sexual interest in patients diagnosed with pedophilic disorder. In the clinical trial with the recruitment of 57 patients and 53 controls, the resulting PFDAQ scores turned out to be correlated with the phallometric measures of the sexual preference for prepubescent children, suggesting the potential of PFDAQ for assessing the level of pedophilic interest. However, the utilization of questionnaires in the clinical setting could result in a variety of disadvantages -including lack of reliability, weak empirical background, high susceptibility of deception- due to the involvement of a high level of subjectivity in the answers [10,11].

2.2 Neuropsychological testing including MFFT, WCST, and Porteus Mazes

The combination of several neuropsychological tests, including the Wisconsin card sorting test (WCST), the Matching Familiar Figures Test (MFFT), and the Porteus Mazes was proposed to be a potential measure for pedophilic interest based on the demonstrations of people with pedophilic disorder having executive dysfunction, abnormal verbal fluency in previous neuropsychological literature [12]. WCST mainly probes cognitive flexibility; both MFFT and Porteus Mazes test for impulsivity [13]. A study conducted, in the purpose of exploring the applicability of the behavioral addiction model to investigate the executive functions that potentially elucidate the addictive behaviors considered to be highly associated with pedophilic disorder, suggested that patients with pedophilic disorder show an abnormality on both cognitive flexibility and impulsivity. They were unable to sustain their attention, displayed long response latency on impulsivity tests, and showed lower maximum correct but higher deductions in the tests of visual analysis and impulsivity [12]. However, these neuropsychological tests were criticized for their high validity only in the reported child sex offenders, but not in the non-admitting perpetrators [14].

2.3 Phallometric testing: current gold standard

Phallometric testing (that is also referred to as penile plethysmography, or PPG) is considered to be the gold standard professional tool to assess people with pedophilic disorder. It measures changes in penile circumference in response to various sexual or nonsexual stimuli [15]. And its implications include being used as a screening tool for people working with vulnerable populations, such as child care takers, or teachers. PPG is considered to be able to distinguish people with pedophilic disorder from either those with hebephilic disorder or those with pedohebephilic disorders (described as the sexual attraction to both prepubescent children and early pubescent adolescents), since both the

sensitivity and the specificity of phallometric testing for its accuracy in distinguishing different patients were different as demonstrated in a great number of studies. Moreover, PPG was suggested to be a reliable tool for identifying an offender's sexual preference in terms of gender and age, as well as finding significant difference between the sex offenders and different comparison groups [16,17,18,19,20]. However, the reliability and validity of phallometric testing was still under concern. Challenges could arise from the possibility of faking in phallometric testing when subjects are able to deliberately distort their sexual preference. It is almost impossible for the researcher to detect this dissimulation [21]. Other challenges also include the distinction between the subjects as well as the lack of standardization in the choice of stimuli and the protocols. In order to minimize the potentially biased factors and to maximize the distinctiveness of the responses from the subjects with psychiatric disorders (e.g., pedophilia, hebephilia, pedohebephilia), a control group that is comprised of presumed non-offenders is typically used. However, due to the lack of tools for absolute assessment of psychiatric disorders and the complexity of the sexual preferences (i.e., show interest in deviant sex), it could be hard to identify participants who are absolutely 100% non-offenders [22]. Moreover, stimuli used in the phallometric testing could differ in various dimensions, such as the medium of presentation, the color, the amount of content, etc. [22] Different stimuli and different durations of stimuli could lead to different responses in terms of levels of arousal, or the duration of arousal. So, to largely compensate for the low reliability of simple difference scores in PGG, Caruso provided an approach of calculating the difference scores for different stimulus sets used [23]. Furthermore, contingent negative variation (CNV) was invented to work in conjunction with PGG. It is typically recorded from central electrodes and used as indices of sexual preference when chosen stimulus based on subjects' PGG responses to children is used [24].

2.4 Binocular eye-tracking system: a promising tool that can be used individually or in a combinatory manner

Binocular eye-tracking system was proposed to be a promising tool for assessing the pedophilic disorder. Previous electrophysiological studies of brain activity have demonstrated that initial eye fixation on a sexually preferred stimulus is the early attentional or pre-attentive automatic process [25]. And it was then found in the study of fixation activity that subjects with pedophilic disorder displayed a longer than average eye fixation duration, suggesting a higher level of concentration on the deviant or preferred stimuli than on the normal or non-preferred stimuli [26]. Moreover, another study conducted by Fromberger indicated that in comparison to the healthy people who focus more on the face, people diagnosed with pedophilic disorder turned out to pay more attention to the public regions of children [27]. These results to an extent demonstrated the prospect of this system serving as an assessment tool to screen for pedophilic disorder, but certain criticisms were put forward indicating that various internal or external factors could greatly attribute to the ultimate result other than subject's sexual preference -for instance, the emotional reaction [28].

3. Treatments/interventions for pedophilic disorder

So far, the etiology and pathogenesis of pedophilic disorder are not well-clarified, and the lack of randomizes clinical trials also limits the potential treatments to supervised correctional settings. Further investigations are still needed. As a result, biomarkers for therapy selection and early diagnosis of pedophilic disorder are not well developed yet, which results in the uncertainty regarding the probable adverse effects of the treatments that are available to the patients now and the efficacy of the prospective interventions that were proposed by the researcher. Current recommended interventions include the combination of psychotherapies and either antidepressants or chemical castration [29]. Treatments for pedophilic disorder could be categorized as either somatic or non-somatic. The somatic ones sometimes cause vehement controversy in public. For instance, chemical castration (the hormone and neurotransmitter therapies) is prohibited in some counties due to ethical concerns of coercion, but is allowed in other countries as long as patients give informed consent [30].

3.1 Structural and functional abnormalities in the brains of people with pedophilic disorder

Pedophilic disorder has been gradually demonstrated to be associated with both structural and functional brain abnormalities, as there is growing evidence indicating that pedophilic behaviors follow both focal and systemic brain diseases [31]. In people with pedophilic disorder, frontostriatal neural loops that are important for the cognitive inhibition capacities are defective whereas cortical and subcortical regions associated with sexual arousal and inhibition (e.g., the frontal cortex, including the anterior cingulate cortex (ACC), the caudate nucleus, and the amygdala) are abnormally activated [32]. Structural imaging also reveals a decreased grey matter volume in the dorsolateral prefrontal cortex, insula, and amygdala in pedophilic patients compared with healthy controls [33]. Despite that the morphological alterations in the brain comprised certain regions, such as the frontal lobes and the hypothalamus, the anatomical location of impairment and dysfunction varied across different studies. As a result, several neurological theories associated with pedophilic disorder were proposed, suggesting that defects in the neurological system could result in pedophilic sexual interest through various mechanisms: behavioral disinhibition due to structural and functional damage to the frontal lobe, and hypersexuality due to lesions of the temporal lobe [34,35]. These theories were later proved to explain the direct consequences of certain neurological disorder, but not the pedophilic sexual interest [36].

3.2 Neurobiological treatments using imaging techniques

Even though these mechanisms were demonstrated to be incorrect, the activation of ACC in the frontal cortex was still proposed to be associated with sexual arousal among pedophiles by Renaud, due to its indispensable role in autonomic functions and cognitive functions such as reward anticipation, decision making, and emotion [32]. This proposal was supported by previous studies of the information-processing model of sexual arousal that sexual arousal, in response to sexually preferred stimuli, was an interaction of both automatic and controlled cognitive information processes which led to a slower decision-making called sexual content induced delay (that is different from the cognitive responses to romantic stimuli) [37,38]. In the paper, Renaud suggested that the real-time functional magnetic imaging (rt-fMRI) brain-computer interface (BCI) application could be a promising treatment for pedophilic disorder [32]. BCI allowed two-way communication between the brain and the computer, and two techniques were able to be applied using neurofeedback -one was the fMRI which could measure the brain activity by detecting the small changes in blood flow, and the other was the electroencephalography (EEG) which allow early detection of brain activity in response to certain stimuli due to its high resolution. Consequently, rather than the EEG-based BCI, fMRI BCI was chosen in their study, enabling them to modulate the subcortical regions in the brain [32,39,40]. The prospective implication of fMRI BCI system is to train people diagnosed with pedophilic disorder in lowering their ACC activation under the exposure of their sexual preferences. This system was also equipped with a virtual interactive sexual stimulus (VISS) system, eye-tracking techniques that measures subject's eye-tracking behavior relative to the VISS, and volumetric PPG that measures subject's psychophysiological input -the penile tumescence. All these subsidiary systems work in conjunction with each other allowing for the control and validation of the sexual arousal induction as well as the detection of subject's overt attention. Similar to the strategies applied in other cognitive behavioral therapies, a strategy of covert mental rehearsal should be used by pedophilia patients, as they have to focus their attention and cognitive activity in response to the virtual reality stimuli generated by VISS repeatedly while the fMRI BCI system is monitoring their ACC neurofeedback that is closely linked to VISS's behavior [41].

3.3 Hormone/neurotransmitters are involved in sexuality

Other than the neuropsychological treatments, the testosterone-suppressing treatments (e.g., antiandrogenic therapy that is commonly called chemical castration) are considered recommended biological interventions currently in counties where chemical castration is allowed ethically [42].

Though previous studies have demonstrated that testosterone is an essential factor that controls the activation of sexual arousal and the level of sexual impulses, no direct connection between the development of pedophilic disorder and the testosterone level has been found. Multiple recent studies have shown that there's no significant association between testosterone level and sexual offending. They reported normal, or even lower testosterone levels in committing people with pedophilic disorder compared to healthy people [43,44]. Furthermore, it was reported that lower free testosterone and higher methylation of androgen receptor were found to be a universal phenomenon for child sex offenders, rather than to be specific for pedophilic patients [45]. However, though testosterone level is demonstrated to be independent of pedophilic tendencies, a decreased testosterone level could still lower the sexual compulsion, thus subduing the pedophilic impulsion [46]. In addition to testosterone, neurotransmitters also play an important role in male sexuality. It was previously demonstrated that the dysfunction in the regulation of monoamine neurotransmitters (e.g., dopamine, noradrenaline and serotonin) could result in the pathophysiology of paraphilic disorders [47]. Different monoamine neurotransmitters could have influence on the sexuality through different mechanisms: dopamine has facilitative effects on sexual excitation and genital reflexes; however, serotonin (5-HT) primarily has an inhibitory effect on sexual motivation [48]. Moreover, other than monoamine neurotransmitters, a neurotransmitter called γ -aminobutyric acid (GABA) was also found in a recent study to be in a reduced level in the dorsal anterior cingulate cortex in pedophilic patients.

3.4 Biological/pharmaceutical treatments for pedophilic disorder

Hormonal treatments using reagents including antiandrogens (e.g., medroxyprogesterone acetate (MPA), leuprolide acetate (LPA), cyproterone acetate (CPA)), luteinizing hormone-releasing hormone (LHRH) agonists, and gonadotropin-releasing hormone (GnRH) antagonist were proposed and tested subsequently in the past years. Their effectiveness on reducing the testosterone levels and thus lowering the risk for pedophilic patients to commit sexual offenses against children were demonstrated [49,50]. Though the mechanism of MPA, as an antiandrogen, does not include the competition with the androgen receptors, its functions in decreasing testosterone levels as well as gonadotropin secretion have been testified in man studies [51]. In early 1980s, daily injection of LPA was found to reduce testosterone to a castrate level and produce effects similar to that of diethylstilbestrol (DES) injection, a pharmacological treatment for prostate cancer [52]. CPA, as a strong and powerful antiandrogen, competes with testosterone and dihydrotestosterone (DHT, that is, a metabolite of testosterone) for androgen receptors. In this way, testosterone levels of the subjects are reduced when they are treated with CPA [53]. LHRH is synthesized in hypothalamus and functions as an activator of the gonadotropic cells to release GnRH and follicle-stimulating hormone (FSH) -hormones that are essential for sexual development and reproduction. LHRH agonists therefore was demonstrated to suppress the secretion of LH and FSH, thus reducing the testosterone level [55].

However, researchers using those reagents in the hormonal therapies have to face the risk that they have the chance to impair the physiological or cognitive conditions of the subjects. It is known that MPA is detrimental to neuronal health and brings negative impacts on brain health and function, as the estrogen-mediated neural protection against excitotoxicity can be impaired by MPA [56]. Other than that, side effects of MPA also includes decreased spermatogenesis, deep vein thrombosis, and gynecomastia [56,57]. CPA was found to cause liver dysfunction, varicose veins [58]. LHRH agonists were demonstrated to be associated with many adverse effects including hot flashes, loss of muscle mass, metabolic syndrome, and osteopenia [32]. Both GnRH antagonist and LHRH agonist are able to reduce the testosterone levels and thereby reduce sexual preference. But GnRH agonist treatment was examined to be relatively better and was considered the standard, as it has fewer adverse events and improved effectiveness, compared to other treatments [59]. Given that hormone has an unbreakable relationship with the brain function, a fMRI study conducted previously on the antiandrogens suggested that antiandrogens could potentially modify amygdala response to visual erotic stimulation, as the key components (KISS1 and its cognate receptor) of the Kisspeptin (KISS1) signaling pathway which contributes to the modulation of reproductive hormone secretion and GnRH neurons are expressed in amygdala [60].

Selective serotonin reuptake inhibitors (SSRIs) were also suggested for pedophilic disorder by multiple case studies [61,62]. It increases the serotonin levels in the brain by blocking the reuptake of the serotonin by the nerve cells, thus allowing more serotonin available in action [63]. Fluoxetine (FLU), paroxetine (PAR), fluvoxamine (FLV), sertraline (SER), and citalopram (CIT) are SSRIs that have been approved for use in clinical interventions and treatments [64]. Sexual dysfunction is one of the adverse effects of SSRIs, thus allowing SSRIs to present great efficacy in the reduction of sexual preference of the pedophilic patients [65,66]. The basic protocol of using SSRIs in the clinical interventions is to find the serotonin abnormalities and to see if the subject has problems controlling impulse. A single argument that justifies the use of SSRIs in the interventions for pedophilic disorder was the link between serotonin and sexuality. It was mentioned in the previous section that pedophilic patients were found to have defective frontostriatal brains in which reduced brain volume in several interconnected areas, including a neurophysiologic circuit of putamen and frontal cortex, was detected. And these areas in the frontostriatal brain were suggested to belong to the serotonergic system [67]. Proposals were made that alternations of certain single nucleotide polymorphisms (SNPs) in the serotonin receptor could be associated with pedophilic disorder. So, several studies on the serotonergic system in pedophilic patients analyzed various SNPs in several serotonin receptor including 5-HT_{2A}, 5HT_{1B}, 5HT_{3B}, HTR_{3A}; however, none of the proposed SNPs were found to be associated with pedophilic disorder [68,69]. It was reported by Jahn that the epigenetic alternations of the methylation pattern in the promoter region of SNPs in the serotonin receptor that were proposed to be potentially linked with pedophilia disorder were shown to be more influenced by environmental factors [69].

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